Virtual Learning Ecosystems: A proposed framework for integrating educational games, e-learning methods, and virtual community platforms

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Abstract

Digitally delivered learning shows the promise of enhancing learner motivation and engagement, advancing critical thinking skills, encouraging reflection and knowledge sharing, and improving professional self-efficacy. Digital learning objects take many forms including interactive media, apps and games, video and other e-learning activities and exercises. The author proposes the use of affordance-based design as an approach to effectively integrate learning objects and experiences into a comprehensive virtual learning ecosystem. The framework enables designers to engage in the purposeful integration of a variety of game types, e-learning methods, and virtual community platforms based on social, technical and educational affordances related to outcome expectancies. Implications of the model for instructional design, instructor training and development, learner involvement in improving instruction, and learner engagement are discussed.

Behavior is a function of a person and his or her environment. -Kurt Lewin

Introduction

The means to acquire knowledge, master skills, and learn to apply what is learned through the design of activities that train personal faculties are evolving in proportion to the proliferation of information and communication technologies (ICT) that continues to transform the way humans work, play, and interact with one another. Individuals have access to an expanding selection of devices, including smart phones, tablets, e-readers, laptops, home entertainment systems, video recorders and computers. According to Statista (2015), the average number of connected devices used per person in the United States is 2.9, with the Netherlands, United Kingdom, Australia and Canada having over 3 per person in 2014. Because of the centrality and transformative impact of ICT to social and economic functioning, ICT literacy has been identified as among the essential critical 21st-century skills for learners any high school or college graduate (Partnership for 21st Century Learning, 2015).

ICT are increasingly being used by educators and students as learning tools in higher education. According to Allen and Seaman (2014) the portion of higher education students in the United States taking at least one online course now stands around 32 percent. For comparison, the first year of the study conducted in 2003 found slightly less than ten percent of all higher education students were taking at least one online course. There continues to be growth in the percentage of learners who are participating in some form of online education. In 2014, the number of higher education students taking at least one online course in 2014 was up 3.7 percent from the previous year, far exceeded that of overall higher education in the same year period (Allen, et. al.,2014). According to the 2014 U.S. National Center for Education Statistics' Integrated Postsecondary Education Data System (IPEDS), over 95% of institutions with 5,000 of more total students reported distance offerings. Simultaneously, the growth of social networking sites has been rapid and widespread. AS an example, in 2015, Facebook passed 1.23 billion monthly active users, 945 million mobile users, and 757 million daily users (Facebook, 2015). The popularity and use of social media sites has prompted examination of social media technologies

(Kivunga, 2015) and calls for integrating social networking sites into academic experiences (Gonzalez, Davis, Lopez, Munoz, & Soto, 2013).

Educational activities and assessments that successfully leverage learning technologies and digital learning material offer many benefits to students, faculty, and institutions. There is substantial evidence that some combination of online and face-to-face educational activities, can be more effective and efficient when compared to traditional classroom models. The US Department of Education's Office of Planning, Evaluation, and Policy Development analyzed over 1000 empirical studies of online learning from 1996 through July 2008. The researchers found that, on average, students in online learning conditions performed better than those receiving face-to-face instruction. Blended learning conditions, or a combination of online and face-to-face instruction, had a larger effect size than online-only conditions when compared to face-to-face instructional methods. Chen, Lambert and Guidry (2010) investigated the impact of web-based learning technology on student engagement and self-reported learning outcomes in face-to-face and online learning environments. The results of their investigation show a general positive relationship between the use the learning technology and student engagement and achievement of learning outcomes. Research conducted by El-Khalili & El-Ghalayini (2014) examined features of the technology, and suggests that more advanced technologies properly designed positively affects student achievement and satisfaction. Additional benefits of use of learning technologies to deliver online education include reduced seat time, greater student access to education, student success and completion, and more scheduling flexibility (Moskal, Dziuban, Upchurch, Hartman, & Truman, 2006).

While there can be numerous benefits associated with learning activities that incorporate learning technologies and digital learning material, contemporary educators are challenged to create learning experiences that properly align learning technologies, content, activities and assessments with increasingly complex academic and professional learning outcomes. Dewey (1948, p. 119) suggests that if the aim of education has a foreseen end, it gives direction to the learning activity; involves careful observation of the given conditions to determine the means available for reaching the end and to discover hindrances in the way; suggests the proper order or sequence in the use of means; and facilitates an economic selection and arrangement of means, making choice of alternatives possible based on relative desirability. Alternatively, unclear aims or a poor alignment of means in creating learning experiences can lead to a host of negative consequences for learners and their stakeholders. The negative consequences of poorly designed instruction may include disgruntled or disappointed students and instructors, poorly used resources, and wasted time and money. Consequently, learner successful interaction with learning technologies and digital learning materials, and their ultimate success, depend on a number of factors.

As more diverse students enroll in online classes, the differences in technological skills and competence among learners widen, and these differences often go undetected by educators (Murphrey, 2010; Bolliger & Wasilik, 2009). A clear understanding of learner needs, learning requirements, and of the potential ways that learners and educators can interact with learning technologies factor heavily in the success of learning experiences. In support of advancing understanding of learner needs, a number of studies have examined the relationship between learners' use of learning technologies and learner satisfaction and effectiveness. Noesgaard & Ørngreen (2015) suggest that learner support and resources, and learners' motivation and prior experience and interaction with digital learning materials influence learning effectiveness. Sørensen & Levinsen (2015) argue that success in digital learning is more likely if students serve as learning designers and engage in formative evaluation activities; i.e. an evaluation that takes place by the students before learning projects occur, with the aim of improving the project's design and performance.

Today there are a growing number of technologies that can be coupled with an increasing body of digital learning material in countless combinations to allow choice and flexibility in facilitating learning experiences. As a consequence, educators face an increasingly difficult task in selecting the right combination of tools and instructional materials for maximum benefit. Sun,Tsai, Finger, Chen, & Yeh (2008) investigated the critical factors affecting learners' satisfaction in e-Learning. The results revealed that learner computer anxiety, instructor attitude toward e-Learning, e-Learning course flexibility, e-Learning course quality, perceived usefulness, perceived ease of use, and diversity in assessments are the critical factors affecting learners' perceived satisfaction. Abdulaziz, AlHomod, & Mohd (2014) argue that thoughtful design is essential to the effective integration of multi-media based E-learning methods. Bower (2008) suggests that the evaluation and selection of appropriate educational technologies is essential to successful implementation of eLearning methods.

While the expansion of technologies and digital learning materials provides additional choice and flexibility to designers of learning experiences, Barry Schwartz (2004) concludes that too many choices, which he refers to as "choice overload," can lead to challenges in designing curriculum and to the personal dissatisfaction of designers. Challenges related to choice overload include the likely burden of gathering information to make a wise decision. Psychological dissatisfaction may arise as a result of: decision paralysis; an Increase in the likelihood that people will regret the selection decisions they make; and an increased feeling of missed opportunities as people encounter the attractive features of options they have rejected to name a few.

Given the increased popularity and use of learning technologies and their relative effectiveness under certain conditions, the challenges inherent in understanding the range of learner needs in an increasingly complex social and technological environment, the expanding choices of learning technologies and digital learning material, and changing requirements relative to an increasingly complex academic and professional learning outcomes, a framework is needed which clarifies the multiplicity of interrelationships and entanglements of learners and teachers, stakeholders, and learning technologies and guides the development of learning experiences that results in learning and performance.

Presented here is a proposed model that can serve to direct the work of instructional designers and developers. The model is based on the entanglements of learners' needs, teacher needs, and stakeholder needs, and the optimal ways that learners engage with curriculum, technologies, other learners, teachers and stakeholders. The model is predicated on designers and educators being a) aware of the optimal available technologies, b) aware of the interoperability of technologies in optimizing the teaching and learning processes, and c) aware of the accessibility and usability of the technologies in meeting learner needs. The author adopts a Virtual Learning Ecosystem model as a conceptual framework. Further, the author incorporates affordance based design theory to clarify the dynamic and optimal relationships of human and non-human interactions that aim to facilitate learning experiences, in order to guide the attention and work of the designers of instruction.

Virtual Learning Ecosystem

The idea of a learning ecosystem as a metaphor holds promise as a holistic framework for representing the multiplicity of interrelationships and entanglements of learners and teachers, stakeholders, and learning technologies and e-learning materials. An ecosystem, according to www.merriam-webster.com/dictionary/ is defined as "the complex of a community of organisms and its environment functioning as an ecological unit." This definition accounts for the necessary interactions between the learners and teacher, and the learning technologies and materials that are both in the environment and in some ways constitute a unique virtual environment. In addition, the ecosystem can be of any size as long as there are relations and interactions exist between people and the physical and virtual environment.

The main purpose and function of the virtual learning ecosystem is to enable dynamic relationships and interactions between humans and digital content, and information flow, knowledge transfer and transformation. As figure 1. illustrates, a simple ecosystem model as applied to virtual learning activities takes into account a) the relations among learners and teachers, b) the relation among learners, teachers and other stakeholders, c) the relations among learners and learning technologies and e-learning material, d) the relations among stakeholders and learning technologies and e-learning materials and e) the type and extent of relations among technologies and learning materials and their interrelationship and interoperability.

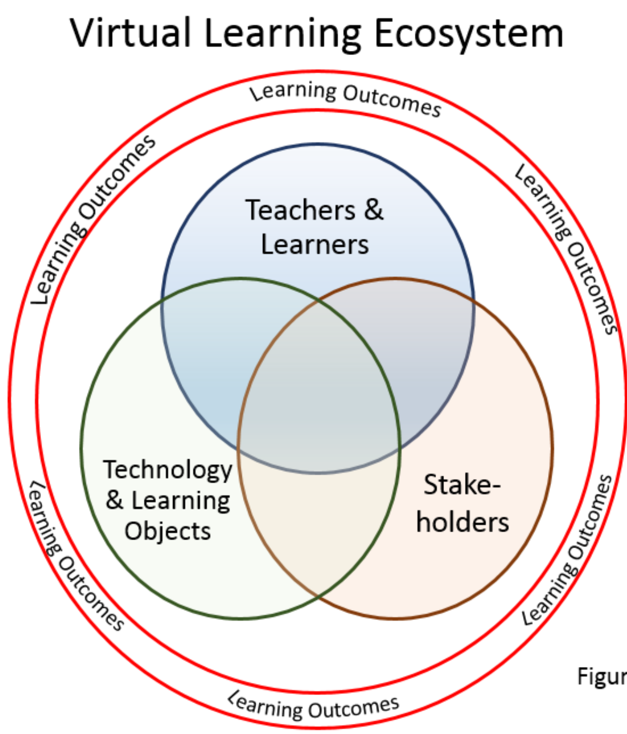

Figure 1

A number of scholars have previously applied ecosystem concepts and frameworks to the teaching and learning process (see Gütl and Chang, 2008, for an extensive review of eco-system-based theoretical models). First, the boundaries of the learning ecosystem defines the physical and logical borders of the learning system. The boundaries of the virtual learning ecosystem are constituted by learning outcomes, which account for the requirements and constraints on human behaviors, learning technologies and e-learning materials. Learning outcomes are the currency of higher education, affording transferability of college learning between institutions, enabling educators to communicate what is to be learned, and supporting learners' ability to communicate what they have learned.

Learning outcomes inform and are informed by a variety of inputs including but not limited to: the educational goals of institutions, learning and performance tasks of employers, cultural and sociological features of communities, and expectations of society, private industry and business organizations, the government, public service and not-for-profit organizations (Chang and Gütl, 2007). Given clear learning outcomes, designers of learning experiences can then determine the appropriate technologies and relevant resources to support learning activity and assessment. For example, these resources can include course content, educational games and simulations, or a teacher or mentor.

In thinking about learning outcomes as boundaries, it should be noted that engagement in the virtual learning ecosystem can lead to boundary spanning activities. For example, the ever-increasing interconnections between learners and stakeholders, facilitated in many instances by technology, often lead to new forms of relationships and new formal and informal learning outcomes. These injects can either have a positive or negative impact on the learning ecosystem. In a similar way, an invasive species of weeds or a toxic chemical may affect a natural landscape. These changes resulting from interactions in the ecosystem potentially expand the boundary of the ecosystem and reflect the dynamic nature of ecosystems in practice.

Secondly, learners and teachers and their interactions are important features of the virtual learning ecosystem. Cowley et al. (2002) suggest that the learners and the teacher are most important to the learning process. In some cases the learners may be more familiar than the instructors with the possible uses of learning technologies. The collaborative nature of learning, the role of learners in developing new content and sharing it, and the role of learners as designers and facilitators through the technology, suggest both an interdependence and a blurring of the roles of teachers and learners in learning activities and assessments.

Third, along with learners and teachers, stakeholders form the living parts of the learning ecosystem. The importance of stakeholder to the learning ecosystem is emphasized by Gütl and Chang (2008). Stakeholders care about the success of learners and may include tutors, content providers, designers of educational games and interactive media, instructional designers and pedagogical experts, and employers. For example, stakeholders may serve to clarify the requirements of learning by articulating workplace requirements, clarifying the rules of games they designed, or clarifying how technology is being used in organizational life.

Fourth, the technologies and virtual learning materials and learning objects represent the non-living parts of the virtual learning ecosystem. This includes the devices, servers, learning media, content and other tools applied to teaching and learning activities, assignments, and assessments. Gütl and Chang (2008) and Bower (2008) describe the role of learning artifacts, resources, and technologies in supporting learning. Bower (2008) suggests that the evaluation and selection of appropriate educational technologies is essential to successful implementation, and proposes a design methodology that matches the requirements of learning tasks with the affordances of available technologies.

In exploring the features and dynamics of virtual learning ecosystem, there can be a multiplicity of designers, multiple learning technologies and educational resources, and multiple teachers and learners. Learning can be contextualized and linked to stakeholder requirements, and to the social and technical processes of work and social life. Individuals can form groups spontaneously and can interact with each other or with learning technologies at the individual or group level. Learners, teachers and stakeholders can perform, change or adapt specific behaviors in order to contribute to or interfere with the designed learning experiences. The ecosystem model can fully account for dynamic activity such as new learning outcomes that expand the boundary of the ecosystem, invasive species and disruptive events.

This initial view of the system components, based on basic principles associated with ecosystems model, helps to get a better picture about the components of the learning environment and the possible interactions between the living and non-living units. However it is the addition of “affordances” to the model, based on affordance based design theory, which provides the basis for understanding optimal interactions between people and technology, instructional means and educational outcomes. It is this additional feature of the model that enables the purposeful integration of educational games and interactive media, e-learning methods, and social media and other community platforms into the design of learning activities and assessments.

Affordance Based Design – A Relational View

Gibson (1979) first coined the term "affordance," as a relational concept, in the field of perceptual psychology. The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. According to Gibson, an affordance implies the complementarity of the animal and the environment. (p. 127, italics in original) In the original description that Gibson provides, an "affordance" is present as long as the organism is physically able to undertake the required action, and as long as the possibility of executing that action is present.

Donald Norman advanced the idea that affordances can also be perceived as actual properties of a thing. He describes an affordance as a design aspect of an object which suggests how the object should be used (1988). For example, a chair affords ('is for') support and, therefore, affords sitting. A chair can also be carried (Norman, 1988, p. 9). Norman suggests that until an affordance is perceived it is of no utility to the potential user.

Lu and Cheng (2013) introduce the concept of perceptual probability of affordance in order to incorporate product architecture into affordance theory. In their view, affordances are properties of the perceived environment that provide probabilities for actions (Lu & Cheng. 2013). Perceptual probability of affordance can be described as the probability that people will perceive a certain affordance. Because an object typically has multiple affordances, the typical function of an object always has the greatest probability to be perceived. For example, the greatest probability of affordance of a pen is "write-able."

According to Maier and Fadel (2009) perceptions of affordances are dependent upon sensing mechanisms. As a result, different people have different thresholds for detecting the same affordance of an object (Lu & Cheng, 2013). Lu and Cheng (2013) coined the term "perceptual threshold of affordance" to emphasize the perception of affordance by individuals. Actions of learners in relationship to learning technology and objects, are dependent in part by the cues they receive from designers and educators of usefulness of those learning technologies and objects. For example, in order to design a good learning activity, a designer would need to emphasize positive affordances of a technology or learning object via course content, video cues, or through instructor manuals.

Classifying Affordances

Some authors have made attempts to broadly classify affordances for the purpose of deriving learning activities from the complex configuration of possible relations among learners, teachers, stakeholder, technologies and learning material. Kirschner, Strijbos, Kreijns, & Beers (2004) present an affordance framework that defines not just technological affordances, but also social affordances and educational affordances as follows:

> Educational affordances: characteristics of an educational resource that indicate if and how a particular learning behavior could possibly be enacted within the context;
>
> Social affordances: aspects of the online learning environment that provide social-contextual facilitation relevant to the learner's social interaction.
>
> E-learning technology affordances support the educational and collaborative design of learning tasks and the action possibilities that are offered to users of technology.

Figure 2 illustrates the affordance architecture within the Virtual Learning Ecosystem Model.

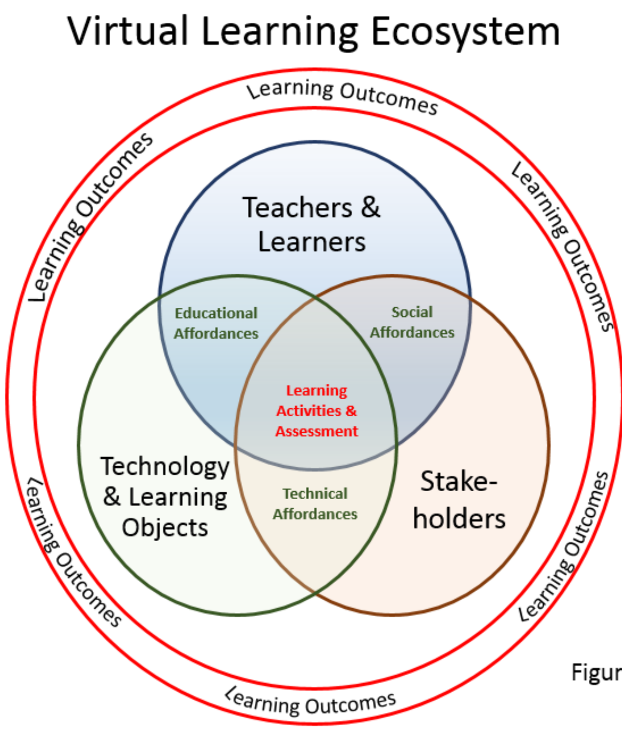

Figure 2

As a way to illustrate the there are multiple affordances associated with the use of technology, and that each specific technology likely has multiple affordances, Kirschner, et. al. (2004) further elaborate on the types of e-learning technology affordances. Terms within the different categories of affordances are defined as abilities, thus emphasizing the action possibilities they offer the user. Some examples of technology affordances provided by Kirchner et. al (2004) include:

(1) Media affordances – the type of input and output forms, such as text ("read-ability", "write-ability"), images ("view-ability", "draw-ability"), audio ("listen-ability", "speak-ability"), video ("watch-ability", "video-produce-ability").

(2) Spatial affordances – the ability to resize elements within an interface ("resize-ability"), move and place elements within an interface ("move-ability").

(3) Temporal affordances – access anytime anywhere (accessibility), ability to be recorded ("record-ability") and played back ("playback-ability"), synchronous versus asynchronous ("synchronicity").

(4) Navigation affordances – capacity to browse to other sections of a resource and move back/forward ("browse-ability"), capacity to link to other sections within the resource or other resources ("link-ability"), ability to search ("search-ability") and sort and sequence ("data-manipulation-ability").

(5) Synthesis affordances – capacity to combine multiple tools together to create a mixed media learning environment ("combine-ability"), the extent to which the functions of tools and the content of resources can be integrated ("integrate-ability").

(6) Technical affordances – capacity to be used on various platforms with minimal/ubiquitous underlying technologies, ability to adapt to bandwidth of connection, speed & efficiency of tool/s.

(7) Usability – intuitiveness of tool, ease with which user can manipulate tool to execute its various functions, relates to efficiency.

(8) Aesthetics – appeal of design, appearance of interface, relates to user satisfaction and ability to hold attention.

(9) Reliability – robustness of platform, system performs as intended whenever required.

Learning Activities and Assessments

Learning activities and assessment are at the center of the proposed Virtual Learning Ecosystem Model. Learning activities are the conditions created by designers for learners to engage in certain social, cognitive, and behavioral processes that result in knowledge acquisition, skill development, and application of knowledge and skills. Active relations between human and non-human elements of the ecosystem cultivate different ways of thinking and behaving for the learners. Through the design of learning activities and assignments, designers of instruction enable learning experiences, behaviors to be performed and human and object affordances to be expressed. For example, since a "smart phone" possesses a multiplicity of real and perceived affordances, the designer may design activities that require the use of applications and features of the device which enable learners to achieve certain tasks, either as individuals, in small groups, or by interacting with stakeholders. For example, learners may use the device to determine the cost of an automobile in another country, to discuss loan rates with actual lean officers in two or more countries, convert currencies in real time using a currency application on the phone, and calculate, upload and compare payment schedules for a fleet of cars over a five year period. As a result of earners creating tangible products of learning, educators could then assess the quality and effectiveness of the student's work within the learning technology.

Design Process

Bower (2008) presents a sufficient design methodology for matching learning tasks with learning technologies. The following steps have been adapted to fit the proposed model, based in large part on Bower' proposed method:

1. Consider stakeholder needs and requirements
2. Identify learning outcomes – decide the overarching intentions of the learning design;
3. Consider learners' needs and requirements
4. Consider learning activities and assignments;
5. Determine the affordance requirements of the learning activities and assignments based on the categories of affordances;
6. Determine the affordances available based on the technological resources being considered, and establish the sets of affordances that can be deployed;
7. Design learning activities and assignments – synergistically integrate the available and required affordances to design learning activities.

The design of learning activities and assignments, in a virtual learning ecosystem, becomes one of nurturing interactions among teachers and learners with stakeholders, and enabling their collective interaction with and through one or more learning technologies and learning objects. In enabling the relations between humans and the learning technologies, designers need to keep in mind that it is the affordances of the technologies and learning objects that determine how the learning objects can best be used. With an increasing volume of interactive media, educational applications and games, video content, and e-learning activities and exercises, designers have a host of learning objects to create learning activities and assignments that enable learners to achieve learning outcomes. Designers can shape the perceptions of affordances of artifacts by specifying the properties that will afford a certain set of uses to teachers and learners. However, the ecosystem model provides the flexibility that learners can perceive specific uses for various technologies and learning objects that extend well beyond the learning outcome intentions and learning outcomes specified by educators and designers of instruction.

Implications

The methodology proposed in this article advocates the process of consciously identifying the affordance requirements of learners and teachers, stakeholders, and the technology and learning objects. In doing so, the requirements of education can be satisfied through learner interactions with others and with technology and learning materials. Focusing on affordances enables designers to consider optimal interaction possibilities among people, learning technologies, and learning objects.

Design serves as the central activity in creating a Virtual Learning Ecosystem, one that incorporates the requirements and support system of stakeholders, and addresses the needs of teachers and learners. Learner success is dependent in large part on the designer's ability to understand the affordance requirements of learners and teachers, stakeholders, and technologies and learning objects, and how they are mutually dependent. To successfully integrate a host of technologies for optimal learner engagement and performance also requires specialized skill in pedagogical methods, learning activity design.

One consequence of this model is related to teacher/instructor training and development. Given the frequency of technology change related to choice and features, teachers and instructors will need to engage in ongoing training related to the capabilities of the learning technologies and learning objects. With modern day technologies enabling learners to connect with other learners and to inject their own goals into the learning process, an additional consequence of the virtual learning ecosystem model is the idea that designers enable learners to play an active role in formative assessment and development of instruction.

Conclusion

Learning technologies, coupled with an increasing quantity of digital learning material (eg. content repositories, educational applications, interactive media objects, online videos, blog sites, and learning platforms), provide educators and learners with anytime and anywhere access to an increasing set of options for developing competence. Increasingly, learners are expecting modern learning environments to employ and support different end-devices, interactive media, and learning objects. The ecosystem model enables designers to intelligently select and employ these technologies and learning materials into learning activities, based on affordances that best support the teaching process in support of learning outcomes.

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